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PATENT SPECIFICATION

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(19)

(54) TRAY FOR THE CONTACTING OF LIQUID AND VAPOUR

(71) We, SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V. formerly Shell Internationale Research Maatschappij N.V., a company organised under the laws of The Netherlands, of 30 Carel van Bylandtlaan, The Hague, The Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to trays for the contacting of liquid and vapour, and is concerned with trays provided with apertures for the passage of vapour and with a plurality of liquid discharge members each consisting of a basin of oblong horizontal cross-section which is open at the top, which basins extend partly above and partly below the tray, with the open top of each basin above the tray, the bottom part of each basin being provided with one or more discharge openings.

The term "vapour" is used herein to include a gas. Such trays are suitable for processes like distillation, absorption and stripping. Sieve trays, grid trays and valve trays can conveniently be employed.

The use of a plurality of such oblong basins as downcomers on a tray renders it possible to discharge the liquid more uniformly from a tray and supply it to the next lower tray than can be done with downcomers disposed adjacent the column wall. Also, a greater weir length can then be obtained, so that operation at a higher liquid load becomes possible. Moreover, the basins serve as liquid/vapour separators, notably for the vapour that can still flow over the edges of the basins along with the liquid. The basins may be provided with baffles in and/or above the open top as catching means for liquid. The positioning of a plurality of basins on a tray requires great care, because liquid flow patterns are greatly influenced thereby. It should also be ensured that the active surface area of the tray remains a maximum. The provision of oblong basins alone results in a favourable ratio of weir length to surface area occupied. This is of importance for processes under elevated pressure, where the liquid load is high. Since developments tend towards operation at higher pressure and larger tray diameters — up to 10 metres — particular requirements will be placed on tray design. The present invention relates to an improved tray.

It is noted that our copending U.K. Patent Applications Nos 5618/72, 5619/72 and 5620/72 relate to various aspects of liquid-vapour contacting apparatus (Serial Nos. 1,416,731, 1,416,732, 1,422,132).

According to the present invention there is provided a tray, of circular or substantially circular cross-section, for the contacting of liquid and vapour, said tray having apertures for the passage of vapour and a plurality of liquid discharge members each consisting of a basin of oblong horizontal cross-section which is open at the top, which basins extend partly above and partly below the tray, with the open top of each basin above the tray, the bottom part of each basin being provided with one or more discharge openings, wherein the tray has a circumferential supporting beam and one or more other supporting beams extending along a diameter and/or a chord of the tray, each of the basins being located so as to lie either between the circumferential supporting beam and the one or more other supporting beams or when a plurality of said other supporting beams are provided between two such other supporting beams.

Advantageously said other supporting beam or beams is or are attached to said circumferential supporting beam.

If there are two or more of said other supporting beams, these may be disposed parallel to one another and symmetrically with respect to a diameter of the tray. The basins may be carried wholly by the beams. This not only imparts great mechanical strength to the — sometimes very large — trays, but also leads to considerable savings, because neither the basins nor the apertured

plate or plate sections which provide(s) the tray with the necessary apertures for the passage of vapour then have to contribute to the strength of the whole and may therefore be of comparatively light design. If the basins are attached not only to the beams but also to the apertured plate, the strength of the whole may be determined by both basins and beams. Various conditions such as tray size, length and number of the basins, and liquid load will decide which construction is the optimum one. The other supporting beam or beams may either be attached to the circumferential supporting beam or entirely separate therefrom, in which latter case they, like the circumferential beam, are individually supported by brackets on the column wall.

It is particularly preferable that the top(s) of the supporting beam(s) should be flush with the top of the tray. The top(s) of the supporting beam(s) may also be provided with vapour passages. Thereby the active surface area of the tray is increased, whilst at the same time passages for liquid are created on the tray between the narrow ends of the basins promoting the mixing and uniform distribution of liquid on the tray.

For the sake of simplicity of design the basins are preferably aligned perpendicular to the other supporting beam(s). The basins may be arranged in parallel rows in such a manner that the basins in any one row are staggered relative to the basins in the or an adjacent row. This further promotes an even distribution of liquid over the entire tray.

The tray may be assembled from apertured plate sections which are attached to said circumferential supporting beam and to said other supporting beam or beams, and/or to said basins. This mode of assembling is especially important for large trays in pressure columns which mostly do not have an easily detachable head. In that case it is better to assemble the trays on the spot.

In the column or column section successive supporting beams of two or more trays may form a structural unit. The supporting beams of large trays in particular may be expensive on account of the heavy construction required. However, combination of the supporting beams of consecutive trays into a structural unit may effect sizeable economies, since large spans are then given vertical support at several points and therefore allow of a lighter design.

When trays provided with basins for the discharge of liquid are installed, care should be taken that the liquid from one tray does not flow direct into a basin of the next lower tray. This may be ensured by providing the basins with adapted discharge openings. If the trays are of identical shape and the basins are placed straight above one another then the openings should discharge liquid flows directed somewhat laterally such that the liquid falls between the basins of the receiving tray.

If the liquid is discharged perpendicularly, the basins of the receiving tray must be in staggered relation to those on the next higher tray. This may necessitate the assembly of trays with two different arrangements of the basins, which has the effect of raising costs. Vertical discharge may be applied with identical trays if the centre of such trays shows a certain deviation from their point of symmetry with regard to the basins. Consecutive trays should then be turned through an angle of 180° (in the horizontal plane) in relation to each other. This configuration and the ones described hereinbefore will be described with reference to the drawings accompanying the provisional specification, in which:

Figures 1, 2, 3 and 6 show trays with various configurations of supporting beams and basins, figures 4 and 5 show details of constructions of such trays, and figures 7 and 8 refer to columns embodying trays in accordance with the present invention.

Figure 1 shows a circumferential beam 1 for a tray 2. Two supporting beams 3 and 4 run parallel along chords of tray 2. Between beams 3 and 4 a plurality of liquid discharge members 5 of equal length have been attached. Between beam 3 and the circumferential beam 1 and between beam 4 and the circumferential beam 1 discharge members 6 and 7 with adapted length have been provided. The tray surface between the discharge members 5, 6 and 7 may consist of perforated, slotted or valve plates, which plates may have been attached to the beams and/or the discharge members. Any unevenness of liquid height between the discharge members is corrected by liquid flow across beams 1, 3 or 4.

In figure 2 and subsequent figures such numerals as have been used hereinbefore have the meaning there given. In this instance a supporting beam 8 is represented. The liquid discharge members 9 and 10 with adapted length are positioned between supporting beam 8 and the peripheral beam 1.

The vertical cross section A—A′ is shown in figure 3. The discharge members 11 of the next higher tray 12 are staggered relative to the members 9 of tray 2. The outlets of the members 11 are directed straight downwards and/or obliquely downwards in a plane normal to the plane of the drawing, so that the liquid falls between the members 9.

Figure 4 shows diagramatically how the discharge members 13 may be attached to a supporting beam 14.

Figure 5 illustrates how two supporting beams 15 and 16 of two consecutive trays may be interconnected by tie rods or beams 17 and thus form a structural unit in order to increase the strength of the trays. Such a construction may be provided throughout the column.

Figure 6 is a top view of a tray design with three supporting beams 18, 19 and 20 with discharge members 21 and 22 of equal length in the intervening spaces and with discharge members 23 and 24 with adapted lengths.

Figures 7 and 8 show how a properly operating column can be obtained with identically designed trays having liquid discharge members with vertical outlets. The tray in the plane of the drawing is provided with discharge members 25, and the next lower or higher tray with discharge members 26. The point 27 is the centre of the tray with discharge members 25. The line 28 connects the centres of the neighbouring discharge members 26 as indicated. Point 27 divides this line into sections which are in the ratio of 1 to 3. If consecutive trays are turned through 180 degrees relative to one another, the liquid discharged from one tray falls just between the discharge members of the next lower tray, as can be seen from the vertical cross section along the line B—B' represented in figure 8.

WHAT WE CLAIM IS:—

1. A tray, of circular or substantially circular horizontal cross-section, for the contacting of liquid and vapour, said tray having apertures for the passage of vapour and a plurality of liquid discharge members each consisting of a basin of oblong horizontal cross-section which is open at the top, which basins extend partly above and partly below the tray, with the open top of each basin above the tray, the bottom part of each basin being provided with one or more discharge openings, wherein the tray has a circumferential supporting beam and one or more other supporting beams extending along a diameter and/or a chord of the tray, each of the basins being located so as to lie either between the circumferential supporting beam and the one or more, other supporting beams or when a plurality of said other supporting beams are provided between two such other supporting beams.

2. A tray according to claim 1, wherein said other supporting beam or beams is or are attached to said circumferential supporting beam.

3. A tray according to claim 1 or claim 2, which comprises two or more of said other supporting beams disposed parallel to one another and symmetrically with respect to a diameter of the tray.

4. A tray according to any one of claims 1—3, in which the top(s) of the supporting beam(s) is (are) flush with the top of the tray.

5. A tray according to any one of claims 1—4, in which the top(s) of the supporting beam(s) is (are) provided with vapour passages.

6. A tray according to any one of claims 1—5, in which the basins are aligned perpendicularly to said other supporting beam(s).

7. A tray according to claim 6, in which the basins are arranged in parallel rows in such a manner that the basins in any one row are staggered relative to the basins in the or an adjacent row.

8. A tray according to any one of claims 1—7, in which the tray is assembled from apertured plate sections which are attached to said circumferential supporting beam and to said other supporting beam or beams and/or to said basins.

9. A tray according to claim 1 and substantially as hereinbefore described.

10. A tray according to claim 1 and substantially as hereinbefore described with reference to the drawings accompanying the provisional specification.

11. A column or column section provided with trays according to any one of claims 1—10.

12. A column or column section as claimed in claim 11 in which successive supporting beams of two or more such trays form a structural unit.

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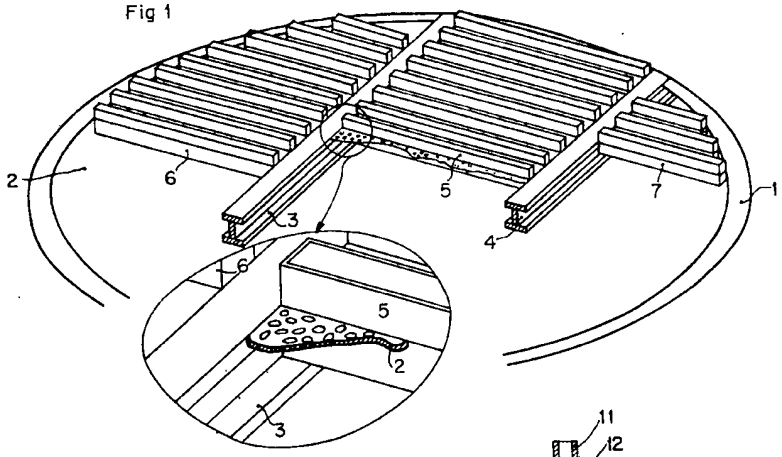
1422131 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig 1



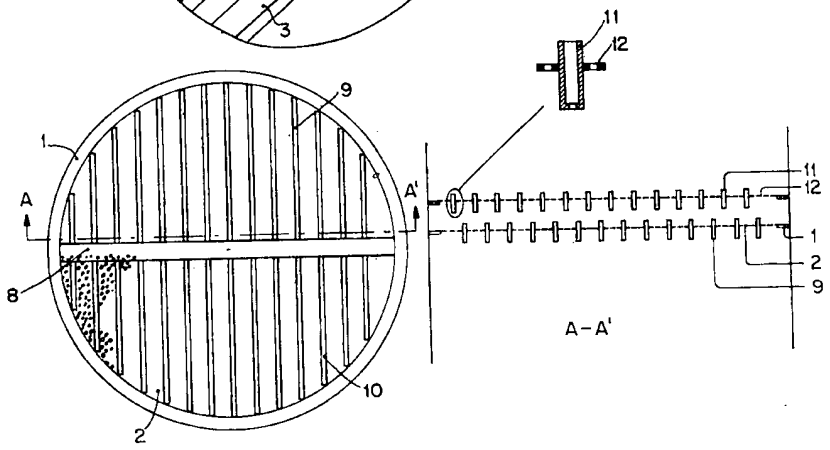


Fig. 2

Fig. 3

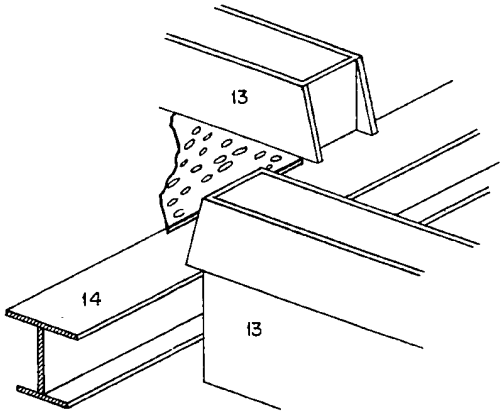


Fig. 4

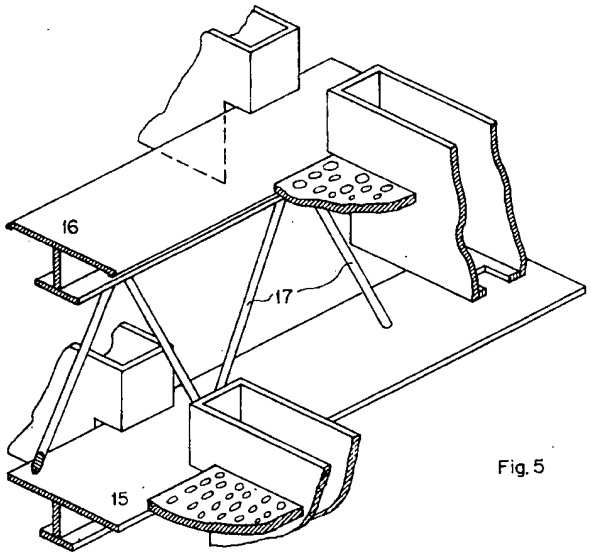


Fig. 5

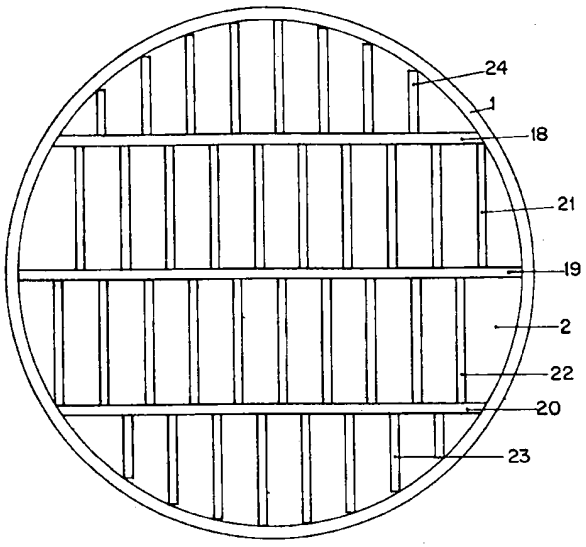


Fig. 6

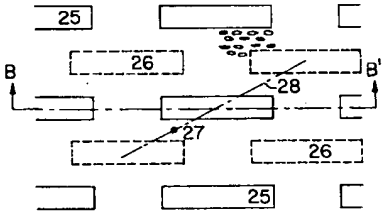
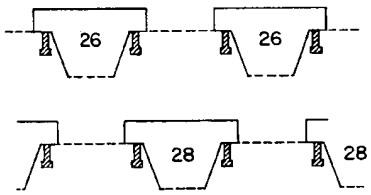


Fig. 7



B-B'

Fig. 8